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ABSTRACT

Safety hazards that are frequently found in science classrooms are addressed in this digest which updates and supplements the 1980 ERIC/SMEAC information bulletin "Safety in the Science Classroom." Information obtained from journal articles and safety guides is presented in the categories of: (1) risks involved in science activities; (2) hazards in chemistry classrooms; (3) hazards in physics classrooms; (4) hazards in biology classrooms; (5) fire; and (6) resources for teachers. Various publications related to safety and safety hazards in science that are available in the ERIC database are identified and described. Guide questions that assist in an assessment of a teacher's familiarity with safety in the science classroom are also provided. A list of 20 references concludes the digest. (ML)

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Clearinghouse for Science, Mathematics and Environmental Education

ERIC/SMEAC Science Education Digest

No. 1, 1986

Safety Hazards in Science Classrooms

The second Environmental Education Digest for 1985, produced by staff of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education, dealt with the topic "Teaching about Hazardous Materials." The focus was on waste disposal and other hazardous materials concerns, and teaching materials related to such problems. This Science Education digest is concerned with another aspect of safety hazards: those frequently found in science classrooms. The materials discussed in this digest are, for the most part, drawn from the ERIC data base and consist of journal articles and safety guides. This digest is not intended to replace the 1980 ERIC/SMEAC information bulletin, "Safety in the Science Classroom," but to up-date and supplement it.

Risks Involved in Science Activities

Science teachers believe that the use of the laboratory is, or should be, an integral part of an effective science program. Involving students in laboratory activities may result in accidents if students are careless in the handling of animals, in their use of chemicals, glassware, heat or electricity. Hazards are present even if demonstrations are conducted. Sievers (1984) has described several "popular, flashy experiments" that are frequently performed at science teachers' meetings or in science classrooms, e.g. the Nassau clock experiment, the ammonium dichromate volcano, and the carbon disulfide-white phosphorous reaction. In his article, Sievers lists toxic or carcinogenic chemicals frequently used in demonstrations or identified in laboratory manuals (1984:32) and suggests safer alternatives. He points out:

> Since high school students usually ignore our warnings that a reaction can be violent, we must come up with informative, creative, but safe experiments. We cannot justify hazardous chemicals and dangerous experiments in high school chemistry classes. Students are not the only ones at risk; teachers who work with hazardous chemicals are exposed to toxins from class to class over a period of years. (1984:32)

Hazards in Chemistry Classrooms

Although chemistry classrooms are not the only science classrooms in which safety hazards are present, chemistry teachers appear to be the intended reading audience for a number of articles related to safety. The *Journal of Chemical Education* regularly prints a section entitled "Safety in the Chemical Laboratory." The topic of one such section was that of the use of temporary labels in the laboratory (Pitt, 1984). Several commonly-encountered problems were described and possible solutions that would avoid danger to individuals working in the lab were proposed. Pitt emphasized that labelling has two functions: to provide information for the main user and to inform others who are largely ignorant of the material but who may come in contact with it.

In the "Provocative Opinion" section of an issue of the *Journal of Chemical Education*, Jay Young stated that the chemistry laboratory in high school or higher education is ten times more hazardous than is the chemical industry workplace (1983). Young speculated that this situation is the result of insufficient dollars, insufficient time, and insufficient faculty concern. He provided a list of errors and omissions often noted in chemistry laboratories and urged chemistry teachers to use it to evaluate their laboratory practices.

The February 3, 1986 issue of *Chemical and Engineering News* carried a special report entitled "Hazardous Wastes in Academic Labs," focused on problems of hazardous waste disposal encountered by colleges and universities as they attempt to safely dispose of chemical wastes, lowlevel radioactive wastes, infectious biological wastes, and other materials. While this article was focused on institution-wide problems, another, entitled "Ether It's Safe or It's Not," contains an account of the problems encountered by one high school teacher whose viewing of a local television news program triggered the hunt for, and discovery of, a 20 year old can of ether in his attic among his personal chemistry equipment (Bealer, 1985). Accompanying Bealer's article is a short response by Jay Young in which he discusses the handling of peroxide-forming compounds. Young cautions his readers, "Do not ever, under any circumstances, open, move, or even touch a container of ether on your shelf that is past its expiration date. In such cases, clear the entire area of people and summon a disposal expert." (1985:31)

Two articles in *Education in Science*, (1980) a British science teachers journal, deal with safety in school science. In "Management and Organization of Chemical Storage," general guidelines for chemical storage are described and a suggested layout for chemical storage is provided. In "The Storage and Handling of Flammable Liquids," some general principles and specific practices are provided, along with a listing of flash points and autoignition temperatures of flammable liquids and the description of a kit for use in clearing up a spill from flammable liquid.

Hazards in Physics Classrooms

One article specifically focused on hazards in physics laboratories was identified. It appeared in *The School Science Review* (1985), another British publication. In this article Orton grouped possible physics laboratory hazards into those dealing with flames and heat; with hazardous chemicals used in teaching about such physical properties as density, refractive index, dispersive power, etc.; with electric current; with radiations; with mechanical hazards such as falling masses, wires under tension, pressure differences; and with miscellaneous hazards such as hyperventilation when attempting to measure lung pressure, overexertion when measuring horsepower, etc.

Hazards in Biology Classrooms

The potential for accidents involving the use of chemicals and of glassware is present in biology classrooms as well as in the chemistry laboratory. In addition the keeping of animals, either a single specimen or colonies, in biology classrooms also poses some risks. Kramer, writing for *Science and Children* (1984), points out that some animals bite, sting, or carry diseases that can be transmitted to human beings. Some human diseases are contracted from animals either through bites or handling while others come from airborne organisms.

An article in *Education in Science* (1979) provides information on the use of pesticides in schools. Pesticides may be found in the biology classroom because teachers use seeds for germination and morphological investigations. These seeds may be dressed with a fungicide/insecticide mixture. Also, plants collected during field trips may be contaminated with pesticides. Fumigants may also be used in greenhouses or animal houses.

Fire

Fire is a hazard that may occur in any science classroom. Fires are classified as to type of material involved: Class A, paper, wood, textiles, and other ordinary combustible materials; Class B, burning liquids (gasoline, oil, alcohol); Class C, electrical equipment; and Class D, water-reactive metals (sodium, potassium, magnesium, powdered aluminum, powdered zinc). Fire extinguishers are part of lab facilities. However, teachers need to know the proper type of ex-

tinguisher to use with a specific fire as well as how to handle the extinguisher. Now that computers are becoming part of the equipment in many science laboratories, science teachers have additional variables to consider when preparing to fight a fire (Nagel, 1985).

The short article by Nagel, cited in the paragraph above, appeared in "Safety Tips" in the *Journal of Chemical Education*. A similar article, with the same title (Fire!), is available in the November, 1985 issue of *The Science Teacher*. In this article Carlson discusses how to handle various types of fire extinguishers and urges science teachers to get instruction in the proper use of extinguishers from their local fire department or to request that the fire department hold a fire safety seminar for teachers.

Resources for Teachers

Various publications related to safety and safety hazards in science are available to teachers using the ERIC data base. Some are safety guides such as "Safety Practices for Science," produced by the Science Section of the Texas Education Agency (1980), or "Safety and Science Teaching" (1984) developed by personnel from the Virginia State Department of Education, or "Better Science Through Safety" (1981) written by Geriovich and Downs. These three publications are designed for science teachers and administrators and deal with legal aspects of school safety as well as provide guidelines designed to promote a safe science classroom environment.

Also available is "School Science Laboratories: A Guide to Some Hazardous Substances" (1984). Produced by the Council of State Science Supervisors, this publication is designed to supplement the National Institute for Occupational Safety and Health (NIOSH) *Manual of Safety and Health Hazards in the School Science Laboratory*. This document contains the identification of certain potentially hazardous substances that may be in use in many school laboratories and provides an inventory of these substances so that science teachers may take the initiative in providing for proper storage, handling, use, and, if warranted, removal of hazardous materials. Lists of explosives, carcinogens, highly toxic, and/or corrosive or irritant chemicals are included, although these lists are not all-inclusive.

"Health Hazards in the Science Classroom" (Trenk, 1977) is a publication produced for the American Lung Association. It contains information about potential health threats that may arise if certain experiments or certain chemical combinations are used in science classrooms. A chart listing dangerous combinations of common school chemicals is included. It is the author's contention that organic chemistry should be discouraged at the high school level.

A series of publications entitled "The Danger of Poison" may be of interest to science teachers. Produced by the Pennsylvania State Department of Education (1985), this series was developed for use with migrant children who may work along side their parents in the fields. It is designed to enable teachers to include topics on the benefits and hazards of pesticides in their science/health lessons. Background information for teachers is provided, along with a course of instruction, visual aids, tests, and teaching materials. This four-level series covers the primary through intermediate grades. English and Spanish versions are available.

Another teaching resource is "The Dilemma of Toxic Materials" (1985). This publication contains classroom tested ideas and resources for science and for social studies teachers relative to toxic and hazardous substances. Designed for use with middle/junior high school students, the document contains instructional activities, annotated lists of audio-visual aids and their sources, as well as appendices containing major toxic substance laws and a guide for hazardous materials disposal.

"Groundwater Quality Protection in Oakland County: A Sourcebook for Teachers" (1981) is another resource for middle/junior high school science or social studies teachers. This document contains information about groundwater protection, household hazardous materials, and projects for students.

Also available is the "Sourcebook on Air Pollution Topics for Grade and High School Teachers" (1984). Designed to provide background information on air pollution to teachers, it also contains suggested experiments and activities for students to carry out to further their understanding of the air they breathe.

A project under way at the Lawrence Hall of Science is termed CEPUP: The Chemical Education for Public Understanding Project. CEPUP has been developed to increase public awareness of, and knowledge about, the benefits and hazards of chemical usage, storage and disposal, and to integrate chemistry with current societal importance. Modules of materials, including up to 50 interactive experiences, are being pilot-tested and will be made available to schools and community groups.

In Summary

A variety of recently-produced resources related to safety in science classrooms exists and is available to users of the ERIC data base. Any science teachers worried about their ability to adequately answer the following questions are urged to locate and use these materials. The questions included are drawn from those asked by Sievers (1984):

- What is your background?
- How current is your knowledge of toxic materials?
- How safe is your lab? What safety equipment do you have and in what quantity?
- What provisions have you taken for the safe disposal of toxic wastes?
- What hazards are involved in the experiment?
- Are the hazards of this experiment well documented?
- What is the toxicity level of the reactants and the products?
- Is there a safer alternative available that will accomplish the same purpose?

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